WHAT IS CLAIMED IS:

1. A high power fiber amplifier system comprising:

means for controlling a pump diode current and a gain of a fiber amplifier, wherein during operation of the system, an output pulse energy is controlled to be constant as a pulse width and repetition rate of output pulses are adjusted.

2. A high power fiber amplifier system as claimed in claim 1, wherein the output pulse energy is maintained at a constant value during a turn-on phase of the pulse train.

3. A high power fiber amplifier system as claimed in claim 1, further comprising:

means for controlling a temperature of the fiber amplifier pump diode such that a wavelength of the pump diode is maintained at a fixed value while a current of the pump diode changes.

4. A high power fiber amplifier system as claimed in claim 1, further comprising:

means for protecting the high power amplifier from damage due to gain buildup in excess of a damage threshold of the amplifier.

5. A high power fiber amplifier system as claimed in claim 2, wherein said protecting means comprises means for monitoring the repetition rate of injected oscillator pulses or an external signal and means for shutting off or reducing the pump diode current if the repetition rate falls below the damage threshold.

6. A high power fiber amplifier system as claimed in claim 1, further comprising:

means for monitoring the amplitude of the oscillator pulses; and

means for protecting the high power fiber amplifier from damage, wherein said protecting means comprises means for either shutting off or reducing the output of the pump diode if the amplitude falls below a predetermined threshold.

7. A high power fiber amplifier system comprising:

a high power fiber amplifier;

a controller operable to control a diode current of a pump diode in said high power fiber amplifier, wherein the pump diode is operable to generate output pulses;

means for setting the pump diode current or power to a desired value;

means for monitoring the pump diode current or power; and

means for maintaining the pump diode current or power at the desired value,

wherein a corresponding energy of the pump diode is maintained in accordance with the desired value as the pulse width and repetition rate are varied.

8. A high power fiber amplifier system as claimed in claim 7, further comprising:

means for initiating operation of the pump diode sufficiently in advance of first pulses; and

means for ramping up the pump diode current to produce equal pulse energy for the first pulses when the system is turned on.

9. A high power fiber amplifier system as claimed in claim 7, further comprising:

means for storing the desired pump diode current setting as a function of system pulse width and repetition rate, wherein the energy of the output pulse is maintained at the desired value as the pulse width and repetition rate are varied.

10. A high power fiber amplifier system as claimed in claim 7, further comprising:

means for calculating the desired pump diode current setting as a function of system pulse width and repetition rate.

11. A high power fiber amplifier system as claimed in claim 7, further comprising:

means for calculating an appropriate pump diode temperature as a function of the pump diode current setting, wherein the emission wavelength of the pump diode is maintained at a wavelength that provides maximum absorption of the pump diode energy by the fiber amplifier medium as the pump diode current is varied.

12. A high power fiber amplifier system as claimed in claim 7, further comprising:

means for storing an appropriate pump diode temperature setting as a function of the pump diode current setting, wherein the emission wavelength of the pump diode is maintained at a wavelength that provides maximum absorption of the pump diode energy by the fiber amplifier medium as the pump diode current is varied.

13. A high power fiber amplifier system as claimed in claim 7, further comprising:

means for monitoring a repetition rate of pulses injected into the amplifier system;

means for comparing the repetition rate of the injected pulses to a predetermined minimum repetition rate; and

means for either disabling or reducing the current to the amplifier pump diode if the injected pulses have a lower repetition rate than the minimum repetition rate.

14. A high power fiber amplifier system as claimed in claim 7, further comprising:

means for measuring an amplitude of a pulse injected into the amplifier system;

means for comparing the amplitude of the pulse being injected into the fiber amplifier with a predetermined minimum amplitude value; and

means for disabling or reducing the current to the amplifier pump diode if the amplitude of the pulse being injected into the fiber amplifier is lower than the predetermined minimum.

15. A high power fiber amplifier system comprising:

means for monitoring a repetition rate of an oscillator; and

means for calculating a required down counter divide ratio needed to obtain a lower repetition rate,

wherein pulses with a desired repetition rate are output even if the oscillator repetition rate varies as a function of time or temperature.

16. A high power fiber amplifier system as claimed in claim 15, further comprising:

means for synchronizing an oscillator with an external reference signal; and

means for varying a frequency of the external reference signal,

wherein a repetition rate of the oscillator varies in accordance with the external reference signal.

17. A high power fiber amplifier system as claimed in claim 16, wherein

a down counted repetition rate is varied in accordance with the external reference signal.

18. A method of operating a high power fiber amplifier system, the method comprising:

varying one or more of a pulse width and a repetition rate of output pulses; and

controlling a pump diode current to dynamically control a gain of the power amplifier to maintain uniform pulse energy as one or more of the pulse width and the repetition rate of the output pulses is varied.

19. A method as claimed in claim 18, further comprising:

maintaining the output pulse energy at a constant value during a turn-on phase of the pulse train.

20. A method as claimed in claim 18, further comprising:

varying a current of the pump diode; and

controlling a temperature of the fiber amplifier pump diode such that a wavelength of the pump diode is maintained at a fixed value while the current of the pump diode changes.

21. A method as claimed in claim 18, further comprising:

measuring a repetition rate of injected oscillator pulses or an external signal;

shutting off or reducing the pump diode current if the repetition rate falls below a predetermined minimum repetition rate,

22. A method as claimed in claim 18, further comprising:

measuring an amplitude of oscillator pulses; and

shutting off or reducing the pump diode if the amplitude of the oscillator falls below a predetermined threshold.

23. A method of operating a high power fiber amplifier system, the method comprising:

controlling a diode current of a pump diode in the high power fiber amplifier system;

setting one or both of the pump diode current and power to a desired value;

measuring one or both of the pump diode current and power; and

maintaining one or both of the pump diode current and power at the desired value,

wherein uniform output energy is achieved as one or more of a pulse width and a repetition rate of output pulses.

24. A method as claimed in claim 23, further comprising:

initiating operation of a pump diode sufficiently in advance of first pulses; and

ramping up the pump diode current to produce equal power for the first pulses when the system is turned on.

25. A method as claimed in claim 23, further comprising:

storing the desired pump diode current setting as a function of system pulse width and repetition rate, wherein the energy of the output pulse is maintained at the desired value as the pulse width and repetition rate are varied.

26. A method as claimed in claim 23, further comprising:

calculating the desired pump diode current setting as a function of system pulse width and repetition rate, wherein the energy of the output pulse is maintained at the desired value as the pulse width and repetition rate are varied.

27. A method as claimed in claim 23, further comprising:

calculating an appropriate pump diode temperature as a function of the pump diode current setting;

varying the pump diode current; and

maintaining an emission wavelength of the pump diode, whereby the maximum absorption of the pump diode energy by the fiber amplifier medium is achieved as the pump diode current is varied.

28. A method as claimed in claim 23, further comprising:

storing an appropriate pump diode temperature as a function of the pump diode current setting;

varying the pump diode current; and

maintaining an emission wavelength of the pump diode, whereby the maximum absorption of the pump diode energy by the fiber amplifier medium is achieved as the pump diode current is varied.

29. A method as claimed in claim 23, further comprising:

measuring a repetition rate of pulses injected into the amplifier system;

comparing the repetition rate of the injected pulses to a predetermined minimum repetition rate; and

disabling or reducing the current to the amplifier pump diode if the injected pulses have a lower repetition rate than the minimum repetition rate.

30. A method as claimed in claim 23, further comprising:

measuring an amplitude of a pulse injected into the amplifier system;

comparing the amplitude of the pulse being injected into the fiber amplifier with a predetermined minimum amplitude value; and

disabling or reducing the current to the amplifier pump diode if the amplitude of the pulse being injected into the fiber amplifier is lower than the predetermined minimum.

31. A method as claimed in claim 23, further comprising:

measuring a repetition rate of an oscillator of the system; and

calculating a required down counter divide ratio needed to obtain a lower repetition rate.

32. A method as claimed in claim 23, further comprising:

varying the repetition rate of an oscillator of the system as a function of time or temperature;

outputting pulses with a desired repetition rate while the repetition rate of the oscillator is varied.

33. A method as claimed in claim 23, further comprising:

synchronizing an output of an oscillator of the system with an external reference signal;

varying a frequency of the external reference signal; and

automatically varying a repetition rate of the oscillator in accordance with the variations of the external reference signal.

34. A method as claimed in claim 33, further comprising:

varying a down counted repetition rate in accordance with the variations of the external reference signal.

35. A high power fiber amplifier system comprising:

a first controller operable to control an electric current of a pump diode and further control a gain of a fiber amplifier, wherein during operation of the system, an output pulse energy is controlled to be constant as a pulse width and repetition rate of system output pulses are adjusted.

36. A high power fiber amplifier system as claimed in claim 35, wherein the output pulse energy is maintained at a constant value during a turn-on phase of a pulse train.

37. A high power fiber amplifier system as claimed in claim 36, further comprising:

a second controller operable to control a temperature of the fiber amplifier pump diode such that a wavelength of the pump diode is maintained at a fixed value while a current of the pump diode changes.

38. A high power fiber amplifier system as claimed in claim 37, further comprising:

a first measuring device operable to measure the repetition rate of injected oscillator pulses or an external signal; and

a shut-off device operable to shut-off or reduce the pump diode current if the repetition rate falls below a predetermined repetition rate threshold.

39. A high power fiber amplifier system as claimed in claim 38, further comprising:

a second measuring device operable to measure the amplitude of the oscillator pulses, wherein said shut-off device is further operable to shut-off or reduce the pump diode if the amplitude falls below a predetermined amplitude threshold.

40. A high power amplifier system comprising:

a seed source operable to generate seed pulses;

an attenuating device operable to receive and attenuate the seed pulses from said seed source; and

a high power amplifier operable to receive and amplify the attenuated seed pulses from said attenuating device,

wherein the amplified seed pulses maintain a uniform energy as one or both of a repetition rate and an amplitude of the seed pulses is varied.

41. A system as claimed in 40, wherein the attenuating device comprises a down-counting function.

42. A system as claimed in 40, wherein said seed source comprises an associated attenuating means different than said attenuating device.

43. A high power fiber amplifier system, wherein the system is a laser amplifier system and comprises:

a monitoring device operable to monitor an emission wavelength of the laser; and

an adjusting device operable to adjust the wavelength of the laser,

wherein increased stability of the laser output is achieved.

44. A high power fiber amplifier system as claimed in claim 43, wherein the monitoring device comprises:

a wavelength locker, wherein said wavelength locker monitors the output of the laser based on a transfer function of an etalon and wherein further the transmission of the etalon is measured and a photocurrent of the etalon transmission is compared with a photocurrent from a reference detector.

45. A high power fiber amplifier system as claimed in claim 43, wherein the system is a laser amplifier system and further comprises:

a fiber Bragg grating in the oscillator, wherein the wavelength of the oscillator is monitored and controlled by controlling the temperature of said fiber Bragg grating.

46. A high power fiber amplifier system as claimed in claim 43, wherein the system is a laser amplifier system and further comprises:

a fiber Bragg grating in the oscillator, wherein the wavelength of the oscillator is monitored and controlled by applying mechanical stress on said fiber Bragg grating.

47. A high power fiber amplifier system as claimed in claim 43, wherein the system is a laser amplifier system and further comprises:

a semiconductor saturable absorber, wherein the wavelength of the oscillator is monitored and controlled by varying the temperature of said semiconductor saturable absorber.

48. A high power fiber amplifier system as claimed in claim 43, wherein the system is a laser amplifier system and wherein the wavelength of the oscillator is monitored and controlled by varying an intra-cavity power of the laser source and adjusting a pump diode output.

49. A high power fiber amplifier system as claimed in claim 43, wherein the system is a laser amplifier system and wherein the wavelength of the amplified high power pulses is monitored and controlled by varying the current of a pump diode.

50. A high power fiber amplifier system comprising:

a master oscillator operable to generate a plurality of uniform laser pulses;

a pulse selector operable to receive the plurality of uniform laser pulses from said master oscillator and output one or more selected pulses chosen from the plurality of uniform pulses;

a pulse attenuator operable to receive the selected pulses from said pulse selector and selectively attenuate respective amplitudes of the selected pulses; and

a power amplifier operable to receive the selected pulses from said pulse attenuator and selectively amplify the attenuated respective amplitudes of the selected pulses.

51. A high power fiber amplifier system as claimed in claim 50, wherein said pulse selector and said pulse attenuator are combined in a single device.

52. A high power fiber amplifier system as claimed in claim 50, wherein said pulse attenuator comprises an acousto-optic modulator.

53. A high power fiber amplifier system as claimed in claim 50, wherein said pulse attenuator comprises an electro-optic modulator.

54. A high power fiber amplifier system as claimed in claim 50, wherein said pulse attenuator comprises an electro-absorption modulator.

55. A high power fiber amplifier system as claimed in claim 50, wherein said pulse selector comprises an optical switch.

56. A high power fiber amplifier system as claimed in claim 50, wherein the attenuated pulses output from said pulse attenuator have progressively increasing amplitudes.

57. A high power fiber amplifier system as claimed in claim 56, wherein output pulses from said power amplifier have a uniform amplitude.

58. A high power fiber amplifier system comprising:

a semiconductor diode operable to generate seed pulses of a laser, wherein an amplitude of respective seed pulses is based on a corresponding amplitude of an input drive current to said diode;

a controller operable to control the drive current to said diode, wherein the drive current is reduced to a non-zero value when a repetition rate of the seed pulses is below a first threshold.

59. A high power fiber amplifier system as claimed in claim 58, wherein after the drive current is reduced to the non-zero value, the amplitude of the drive current is once again increased when the repetition rate of the seed pulses is higher than a second threshold, wherein the first and second thresholds can be equal.

60. A high power fiber amplifier system as claimed in claim 59, wherein the increase in the drive current is controlled to ensure that the respective amplitude of each of a plurality of desired seed pulses is uniform and equal to a desired value.

61. A high power fiber amplifier system as claimed in claim 60, wherein the respective amplitude of each of one or more initial seed pulses is between the non-zero value and the desired value.

62. A high power fiber amplifier system as claimed in claim 61, wherein a time period during which the initial seed pulses are provided is approximately equal to a fluorescent lifetime of an active ion of said laser amplifier.

63. A high power fiber amplifier system as claimed in claim 58, wherein said diode is controlled to output supplemental pulses when the repetition rate of the seed pulses is below a third threshold.

64. A high power fiber amplifier system as claimed in claim 50, further comprising a controller operable to determine a repetition rate of the uniform laser pulses of said master oscillator and further operable to reduce, to either zero or a non-zero value, a current provided to a pump diode of said power amplifier.

65. A high power fiber amplifier system as claimed in claim 64, wherein said controller reduces the current provided to the pump diode when the repetition rate of the uniform laser pulses is other than a nominal value.

66. A high power fiber amplifier system as claimed in claim 65, wherein said controller reduces the current provided to the pump diode when there is a predetermined difference between the repetition rate of the uniform laser pulses and the nominal value.

67. A high power fiber amplifier system as claimed in claim 50, further comprising an external timing source operable to generate a reference timing signal, wherein the uniform laser pulses from said master oscillator are synchronized to the reference timing signal.

68. A high power fiber amplifier system as claimed in claim 67, further comprising an optical laser cavity comprising at least one end mirror, wherein a position of the at least one end mirror is controlled to achieve the synchronization of the reference timing signal and the uniform laser pulses.

69. A high power fiber amplifier system as claimed in claim 67, further comprising a mode-locked fiber oscillator, wherein a fiber in the oscillator is stretched to achieve the synchronization of the reference timing signal and the uniform laser pulses.

70. A high power fiber amplifier system as claimed in claim 69, further comprising a phase-locked-loop operable to compare a corresponding phase and frequency of the reference timing signal with a corresponding phase and frequency of the uniform laser pulses and the fiber is stretched based on a result of the comparison.

71. A high power fiber amplifier system as claimed in claim 67, further comprising a mode-locked fiber oscillator, wherein at least one end mirror of the mode-locked laser's optical cavity is mounted on a movable element to achieve the synchronization of the reference timing signal and the uniform laser pulses.

72. A high power fiber amplifier system as claimed in claim 71, wherein the movable element comprises a piezoelectric transducer.

73. A protection system for a pulsed fiber amplifier system, comprising:

an external timing reference device operable to generate output signals synchronized to an output of the pulsed fiber amplifier system;

monitoring means for monitoring a time period between trigger pulses; and

control means for initiating the addition of additional seed pulses upon a determination that said time period has exceeded a predetermined limit, whereby the energy of the amplifier can be extracted and damage to the amplifier prevented.

74. A high power fiber amplifier system comprising:

a master oscillator operable to generate a plurality of uniform laser pulses;

a pulse attenuator operable to receive the selected pulses from said pulse selector and selectively attenuate respective amplitudes of the selected pulses;

a power amplifier operable to receive the selected pulses from said pulse attenuator and selectively amplify the attenuated respective amplitudes of the selected pulses; and

a controller operable to determine a repetition rate of the uniform laser pulses of said master oscillator and further operable to reduce, to either zero or a non-zero value, a current provided to a pump diode of said power amplifier, wherein said controller reduces the current provided to the pump diode when the repetition rate of the uniform laser pulses is other than a nominal value.